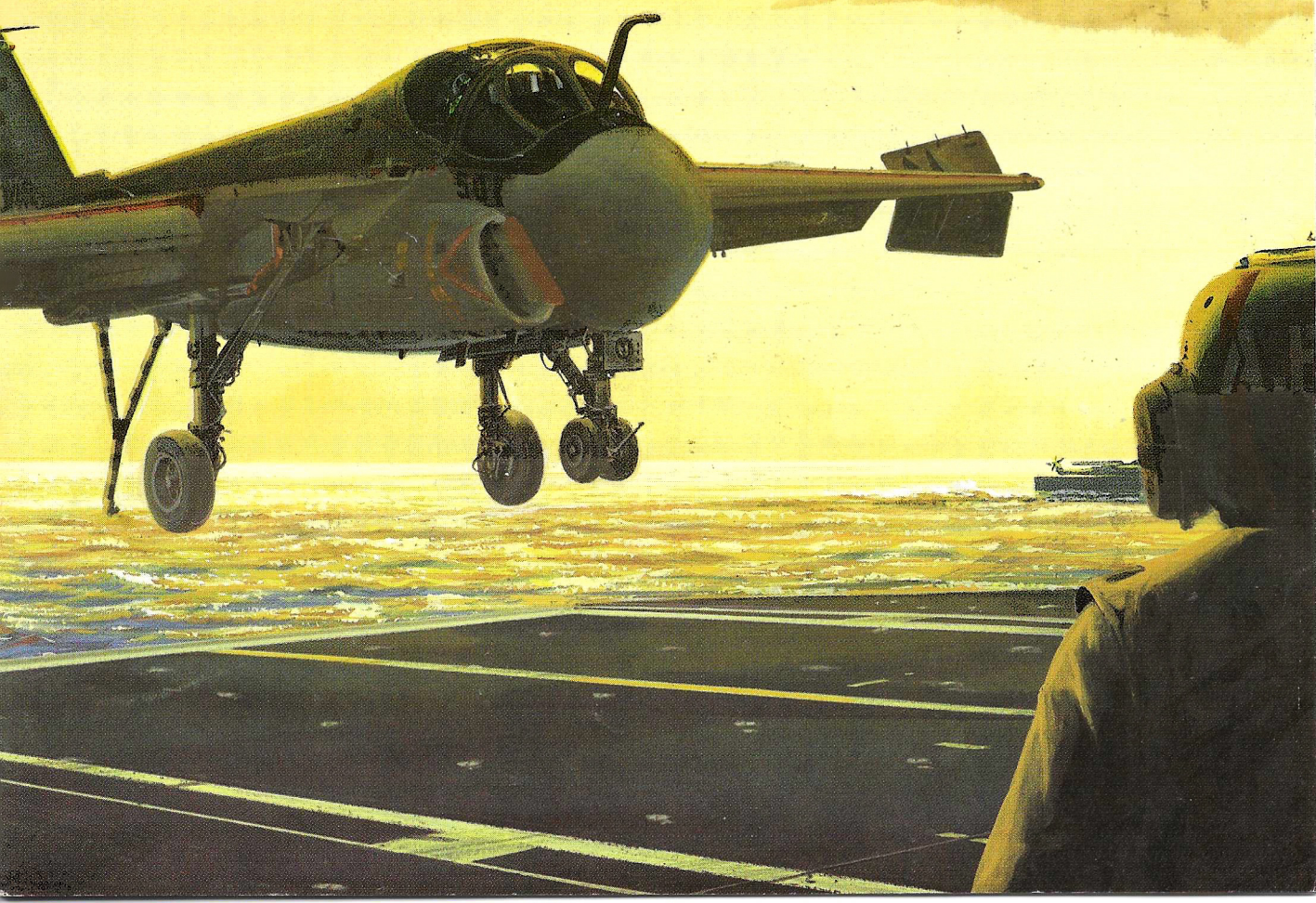


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Cover: Harris support systems technology helps keep our defense forces fit and ready to fight on land, in the air, and at sea.

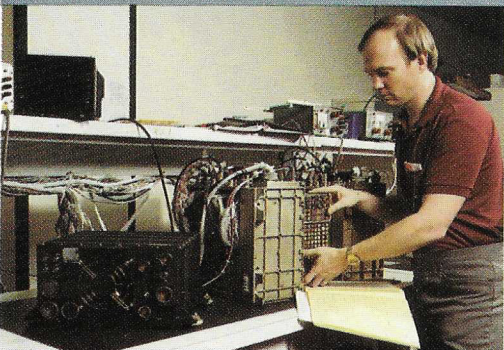
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VOLUME XI-IV, DECEMBER 1985

Timely Technology for an Audience of International Communicators



The Air Force's Precision Location Strike System locates and identifies enemy radar to set up a strike. Read about the key role played by Harris in *PLSS: When Precision Counts* beginning on page 1.



Innovative engineers in both the U.S. and Italy have combined their expertise to design the Agusta A-129 helicopter which uses the Harris Integrated Multiplexing System. Learn more about this winning combination in *The Ultimate Electronic Helicopter* on page 4.



Downtime for defense systems can be fatal. Read how support systems technology from Harris is helping our defense forces stay fit and ready for action in *Expanding Our Support for National Defense* on page 7.

Editor Robert H. Rosequist
Contributing Editors Mark Russell
Ann Samuels
Kathe Riley
Mike Druckenmiller
Mary Denton
Graphic Design Rea Hadley
Cover Art Jay Harrelson

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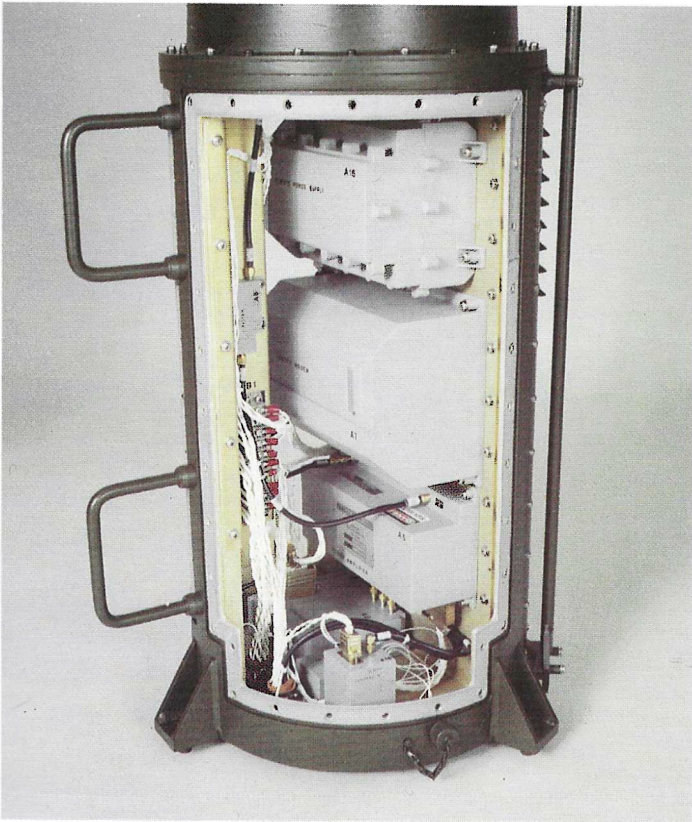
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PLSS: ***When Precision Counts***

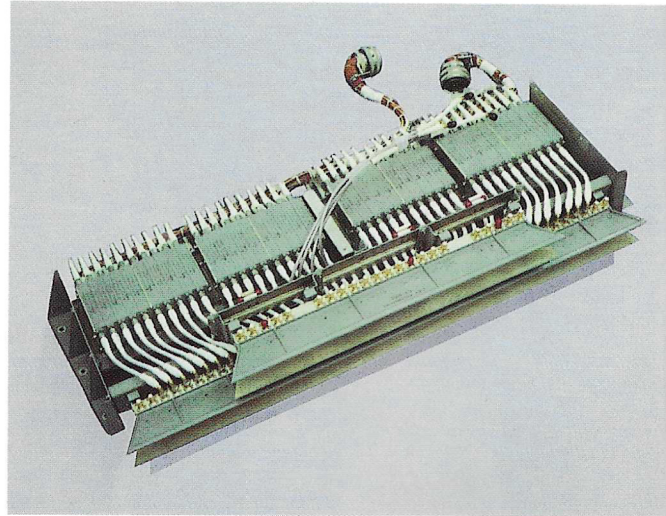
Pinpointing hostile radar and directing accurate strikes against it are key to countering enemy anti-aircraft and artillery. Harris technology points the way.

Three high flying TR-1 reconnaissance aircraft fly racetrack patterns behind the forward edge of the battle area. Their mission—to serve as listening platforms for a system that counters radar-directed anti-aircraft and artillery. The aircraft detect the pulse of an enemy radar and transmit signal direction and time of arrival data to a ground processing station.





This receiver is part of the Airborne Mission Subsystem (AMS) that is mounted aboard TR-1 reconnaissance aircraft in super-pods beneath the wings.



The Site Navigational Subsystem (SNS), tower-mounted and battery-operated, is a half-duplex terminal that can both transmit and receive. Here, the amplifier, modem, and power supply are visible.

The station's computers analyze the data, comparing inputs from the aircraft, to identify the signal and pinpoint its location. This information is transmitted to a tactical air control center, where attack decisions are made to direct strike aircraft to the target. The threat has been countered.

The success of this mission, set in the projected battlefield of the future, depends on determining the exact location of the enemy. To do this, the ground processing station must know the exact position of each TR-1 when it receives hostile radar pulses. The Air Force's Precision Location Strike System (PLSS) furnishes this information, identifying and locating enemy radars to set up a strike. Lockheed Missile and Space Company is the prime contractor on the program, and Harris is a major subcontractor, providing key air- and ground-based Distance Measuring Equipment (DME).

The **Airborne Mission Subsystem (AMS)**-DME flies aboard the TR-1 in wing-mounted super-pods. Physically, the AMS-DME on both pods consists of transmitters, receivers, and antenna

units, with an additional command and control modem, modem power supply, and transformer/rectifier unit in the left pod. Functionally, the AMS-DME operates as a full-duplex terminal capable of simultaneously transmitting and receiving information in the same time slot over independent transmit and receive channels.

The tower-mounted, battery-operated **Site Navigational Subsystem (SNS)**, however, is a half-duplex terminal capable of operation in both transmit and receive modes, but not simultaneously. The SNS-DME is set up on a presurveyed site, using sectorized antennas to transmit precise location information.

With the AMS-DME functioning as interrogators and SNS-DME functioning as transponders, data transmitted from the ground station can be used to calculate the position of each TR-1 and, in turn, the precise location of enemy radar.

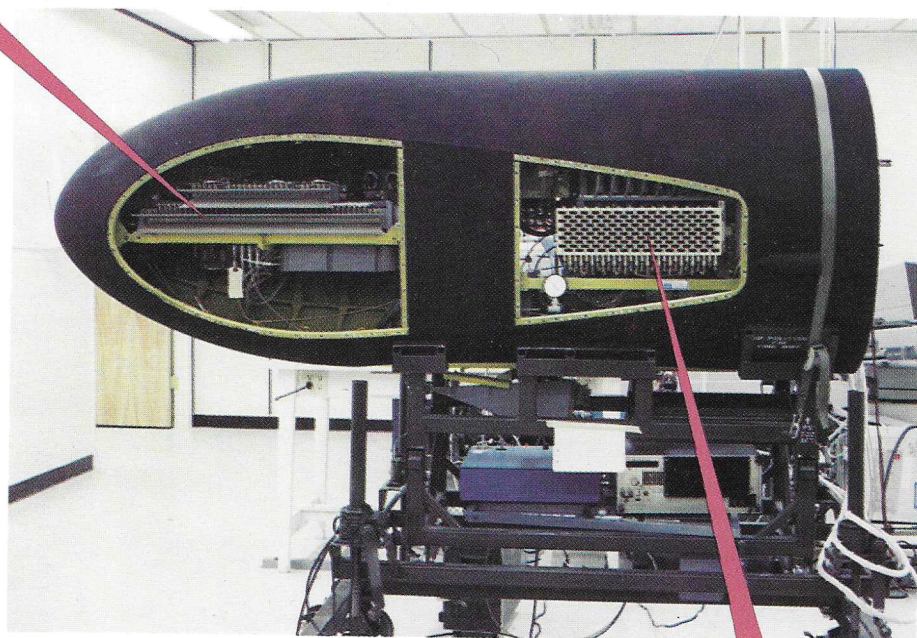
To give PLSS its substantial protection against radar jamming, Harris employed spread spectrum, time division, multiple access technology. Each second is divided into time slots and each terminal is assigned a specific address

for communications. In a prearranged sequence, signals are transmitted in the form of short duration bursts. Receive channels clock the desired transmission data into memory at the prearranged PN code and forward it to the end user in the form of a continuous bit stream.

PLSS, with the AMS and SNS-DME, is currently being flight-tested by the Air Force, and Harris has developed more DME for projected use aboard strike aircraft such as the F-16. The hardware of the **Vehicle Navigation Subsystem** (VNS) is, except for the antenna, technically identical to that of the SNS-DME, and the VNS performs the same function as the SNS, providing a transponder that is interrogated by the TR-1 to determine the relative position of the strike aircraft.

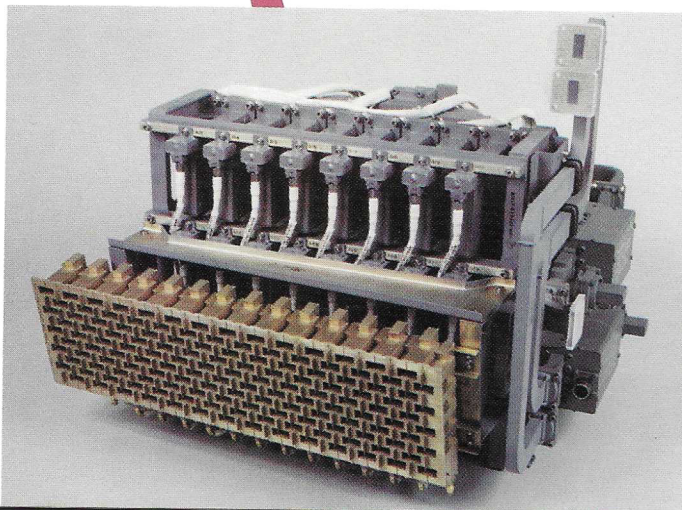
Although PLSS is currently in full-scale development for the 1980's and beyond, the system has its roots in the early 1970's with the Advanced Location and Strike System (ALSS). North Vietnamese radar operators were trained to operate their equipment intermittently to avoid detection. ALSS overcame this tactic, but hostilities ended before the system could be produced.

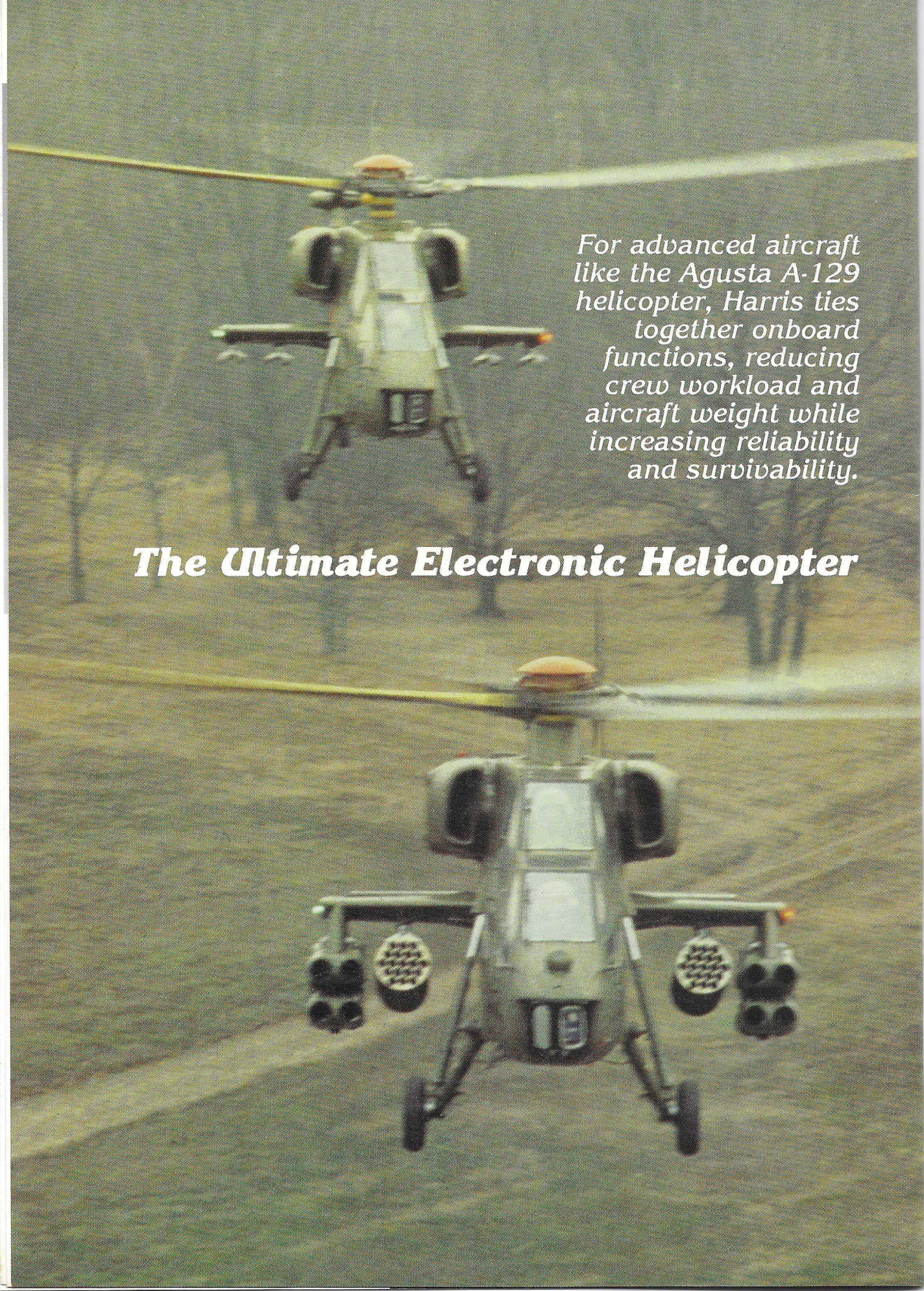
This is a major capability of PLSS, the target engagement system that gets the job done in spite of evasive tactics, electromagnetic interference, and adverse weather conditions. PLSS counters the highly mobile threat environment on a near real-time basis, and Harris-built DME is the heart of the system.



The forward portion of an AMS super-pod reveals the transmitter and receiver mounts. Other pod-mounted equipment includes antenna units, a command and control modem, a modem power supply, and a transformer/rectifier unit.

This transmitter and the other components of the AMS operate as a full-duplex terminal capable of simultaneously transmitting and receiving in the same time slot over independent transmit and receive channels.



The image shows two Agusta A-129 attack helicopters in flight over a field. The helicopter in the foreground is closer to the viewer, showing its landing gear and armaments. The second helicopter is further back and higher up. The background consists of a line of trees and a hazy sky.

For advanced aircraft like the Agusta A-129 helicopter, Harris ties together onboard functions, reducing crew workload and aircraft weight while increasing reliability and survivability.

The Ultimate Electronic Helicopter

Whirling and hovering above the admiring observers at the last Paris Air Show, the new Agusta A-129 helicopter, or Mongoose as it is called, revealed itself to be far ahead of others in its class. That includes those already flying as well as those still on the drawing boards.

Smaller, lighter, and more survivable, this antitank/scout aircraft is the ultimate electronic helicopter. It is the first helicopter to have been designed with an Integrated Multiplex System (IMS). Developed by Harris Government Aerospace Systems Division, the IMS handles and monitors the aircraft's electronic equipment packages and flight control systems.

The A-129 was designed for the Italian Army, with an eye toward markets in the North Atlantic Treaty Organization. The helicopter's primary mission is to attack armored tanks, with a secondary role of scouting and suppressing ground fire. The design had to be flexible enough to accommodate a wide range of armament systems and allow for future growth of its capabilities.

The twin-engine aircraft carries a pilot and copilot/gunner in a tandem-seat (fore and aft) cockpit. The Harris IMS provides them with instant, precise information about the aircraft's performance, capabilities, and well-being. In order to do this, every measuring and sensing device outputs signals to the IMS. The IMS contains redundant centralized data processors, and uses redundant Military Standard

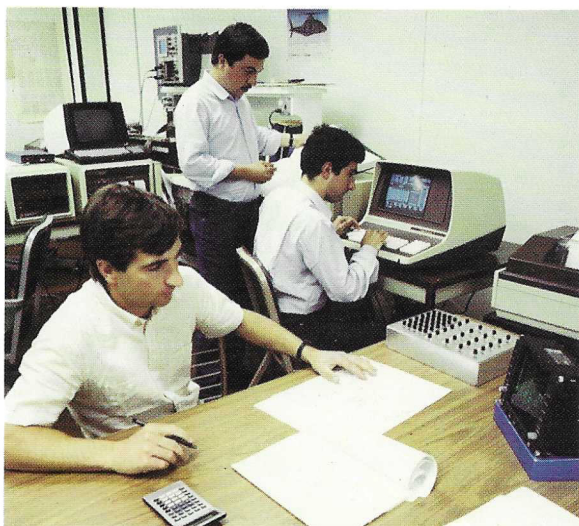
(MIL-STD 1553B) digital data buses for communications between the various subsystems. The pilot can obtain data or control functions and subsystems through "pages" viewed on a multifunction display regarding communications, navigation, flight control, weapons control, engine condition, transmission and hydraulics, fuel system, electrical power distribution, performance monitoring, checklists, and cautions and warnings.

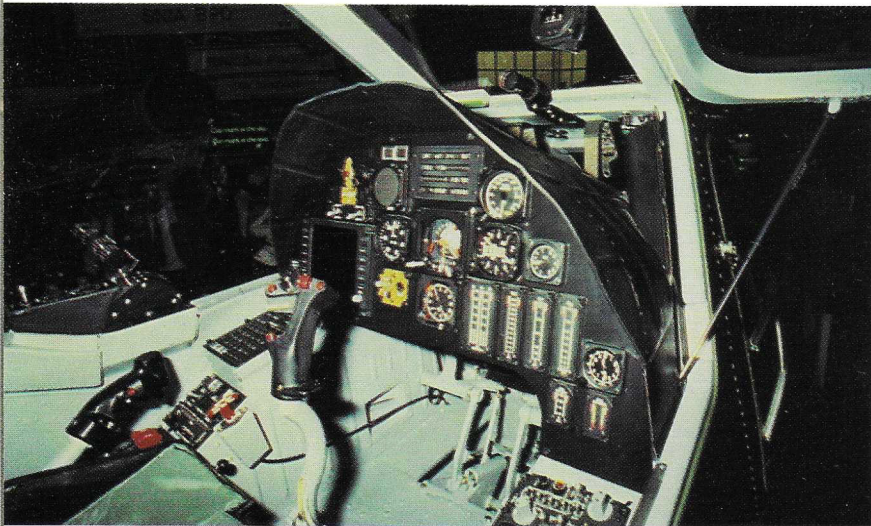
The IMS has replaced a multitude of controls, switches, indicators, displays, and lights normally found in the cockpit with a single multifunction keyboard unit and a video-type multifunction display unit for each crew member. The IMS is managed by two redundant central computers, each capable of operating the system on its own. The IMS computer can store up to 100 navigation waypoints, 10 flight plans with 10 waypoints each, and 100 preset stations or frequencies on high frequency (HF), very high frequency (VHF), and ultra high frequency (UHF) radios. Navigation is controlled by the IMS navigation computer coupled to a Doppler radar, gyros, accelerometers, and air data sensors. A synthetic map on the multifunction display exhibits waypoints, targets, and dangerous or friendly areas.

As an example of how the system works, the "Cruise Performance" display tells the pilot what performance and efficiency he is currently achieving, while the "Cruise Capability" display offers a set of alternative cruise modes at various power settings, taking into account such things as external weapons drag (or reduction in drag, if any weapons have been launched), reduced weight as fuel is burned, plus a range of Estimated Times of Arrival (ETA s) with associated "maximum time over target" figures.

The A-129's small size and requirement for unprecedented flexibility presented Harris with a unique challenge in developing the IMS. The Harris solution was to reduce each major subsystem to its prime factors: sensors, controls and displays, and computational requirements.

Engineers from the Agusta company in Italy came to Harris to collaborate as the program progressed to assure that the IMS would meet the new helicopter's design requirements.





The IMS is shown installed in the cockpit of the A-129. A single multifunction keyboard unit and one or more video-type multifunction display units for each crew member replace a multitude of controls, switches, indicators, displays, and lights normally needed in a helicopter.

All control and display functions and all computing functions have been removed from the discrete subsystems and located in one central set of multipurpose equipment. Then, the equipment was made entirely redundant—at less cost and weight than a nonredundant, serial configuration.

In the Harris configuration, all sensors and control elements interface with the central computing function either directly or through a remote conditioning interface. If there is battle damage or other failure during the mission, the central computer assesses the damage and automatically reconfigures the system to a backup mode, enabling the mission to continue.

Additionally, the direct interface between the sensors and the system make it possible to provide sophisticated software functions not found in any other helicopter or aircraft. These functions include performance monitoring, electrical system management, historical maintenance data recording, weapons delivery coupling to autopilot, and reversible fly-by-wire.

Earlier avionic technology used dedicated wires going from each device, all the way to the computer. This required a very extensive—and very heavy—cable assembly. So, besides providing the pilot with fast, accurate system operation and status, the Harris IMS also achieves substantial weight and cost savings.

The first flight of Agusta's A-129 took place in September 1983 at the Agusta helicopter plant

in Cascina Costa, Italy, near Milan. More than 1,500 hours of flight tests are scheduled to finalize the aircraft's design and establish its flight envelope. The first production A-129 is scheduled for delivery in the near future, with an initial operating capability 1 year later. The Italian Army is scheduled to receive a number of A-129's of which six will be trainers. Agusta has begun talks with Spain, Greece, Great Britain, the Netherlands, Abu Dhabi, and several other countries in the Middle East and South America. And there is a strong possibility of marketing more than 300 helicopters throughout the world.

The winning combination of Harris and Agusta technologies has produced the helicopter of the future—today.

Harris technicians assemble the intricate electronic circuitry for the multiplexing system.



Expanding Our Support for National Defense

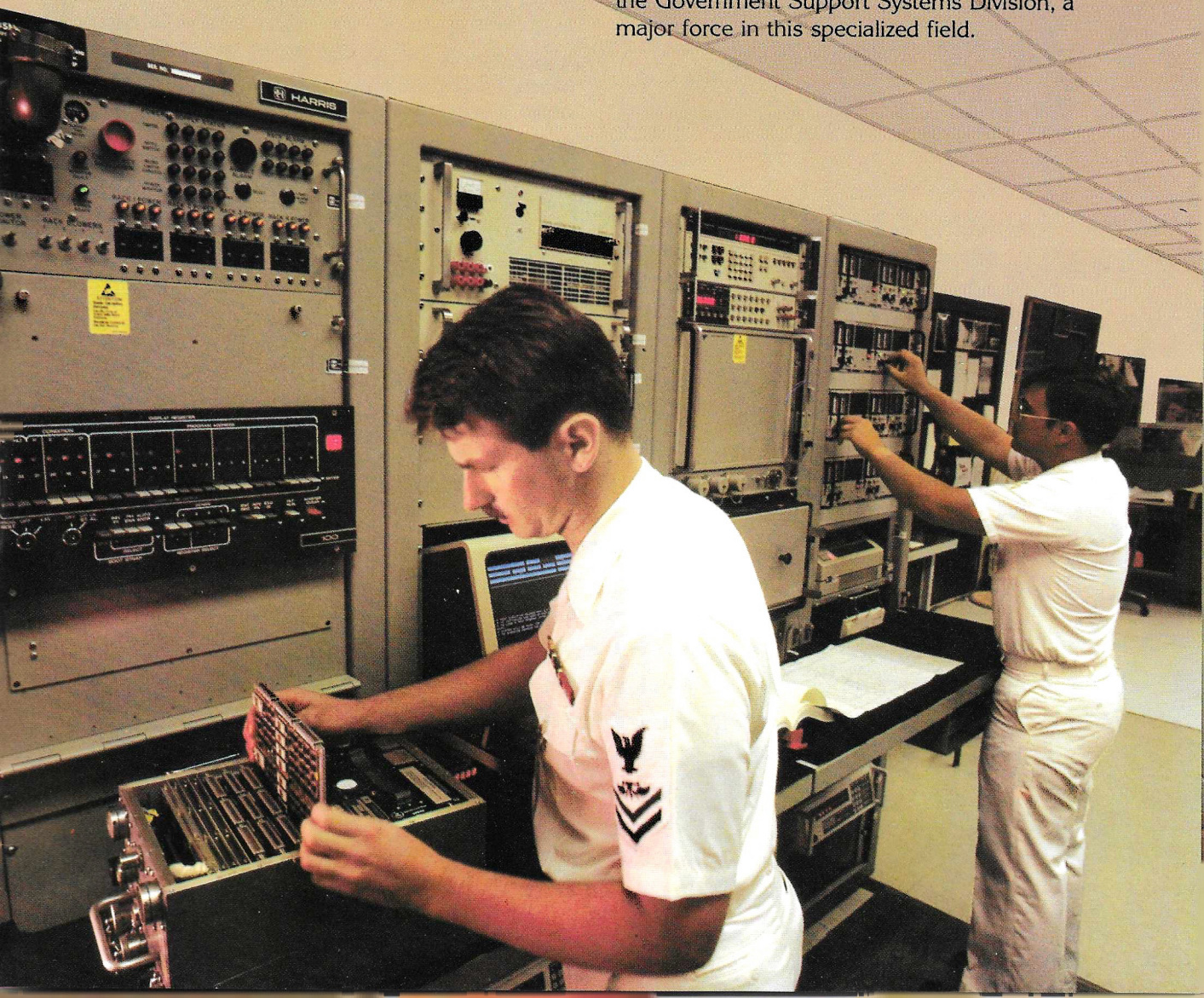
When every second counts, it is critical for defense systems to be fit and ready to fight. Harris is expanding its technologies and capabilities to further maintain and support our defenses on land, in the air, and at sea.

At a time when budgets for many defense programs are being trimmed, U.S. Department of Defense (DOD) expenditures for test equipment remain steady. A recent Frost and Sullivan market analysis report estimated the value of DOD prime contracts for test equipment during

FY 85 at \$0.3 billion higher than that of the previous year. According to the report, this figure is expected to increase still another \$0.8 billion during FY 86.

Today's interest in test equipment development is largely due to the pressing need to maintain a defense force that is becoming more and more technically sophisticated. Advanced defense systems, complex mission requirements, and limited manpower resources need automated test systems that can reduce both repair turnaround time and repair costs.

Harris supports the military services' automatic test equipment needs through the efforts of the Government Support Systems Division, a major force in this specialized field.



State of the art simulation systems for DOD training applications are under development at Harris Government Support Systems Division's Orlando Operation.



For more than 30 years, this division (formerly PRD Electronics) has been chartered to develop electronic support systems for a wide range of communications, avionic, and other electronic applications. Included in its product lines is a family of high-performance, general purpose, programmable automatic test systems that currently support more than 250 major avionic systems on board military aircraft and missiles. The division also produces test equipment for modules, printed circuit boards, cables, and mechanical devices; maintenance management systems; data and inventory control systems; and electronic instruments for measurement, test, and control.

Harris became a noted name in the test systems industry following the company's development of one of the first automatic test systems, the Versatile Avionic Shop Test (VAST). Delivery of this 14-rack system to the U.S. Navy began in 1969, and to date, more than 100 VAST systems have been built for Navy carriers and stations around the world.

With an average 95 percent availability during its nearly 4 million hours of operation, VAST is a proven winner. Due to the system's consistent outstanding performance, the Navy expects to continue using VAST to support its F-14, E-2C, A-7E, and S-3A aircraft through the 1990's. As part of this long-range plan, the Navy has established the Service Life Extension Program currently under way at Harris to upgrade the Navy's VAST systems.

Evolving from VAST technology is a series of more compact automatic test systems, including the ATS(V)1, a six-rack system used to support F/A-18 aircraft, and the ATS(V)2 system, a five-rack system that supports the Navy's Light Airborne Multi-Purpose System (LAMPS) MK III helicopter. The Hybrid Test System, another offshoot of VAST technology, is a four-rack system currently supporting F/A-18, A/6E, EA-6B, AV-8B, S-3B, and A-4 aircraft as well as the LAMPS MK III helicopter.

A manufacturing facility in Ft. Walton Beach, Florida, produces many of the printed circuit boards used in Harris support systems.



For Harris, these systems have provided the company with a solid reputation in both foreign and domestic markets, leading to continuous growth of Harris Government Support Systems Division.

"Five years ago, we had 1,200 employees and booked new orders of about \$55 million per year," said Dick Hartig, vice president of business development for the Government Support Systems Division. "Today we have over 3,000 employees on Long Island, New York; in Orlando, Florida; in Ft. Walton Beach, Florida; and in field offices across the U.S. Our growth rate in new orders has been terrific—more than 25 percent per year. Last year alone we turned in new orders of around \$235 million."

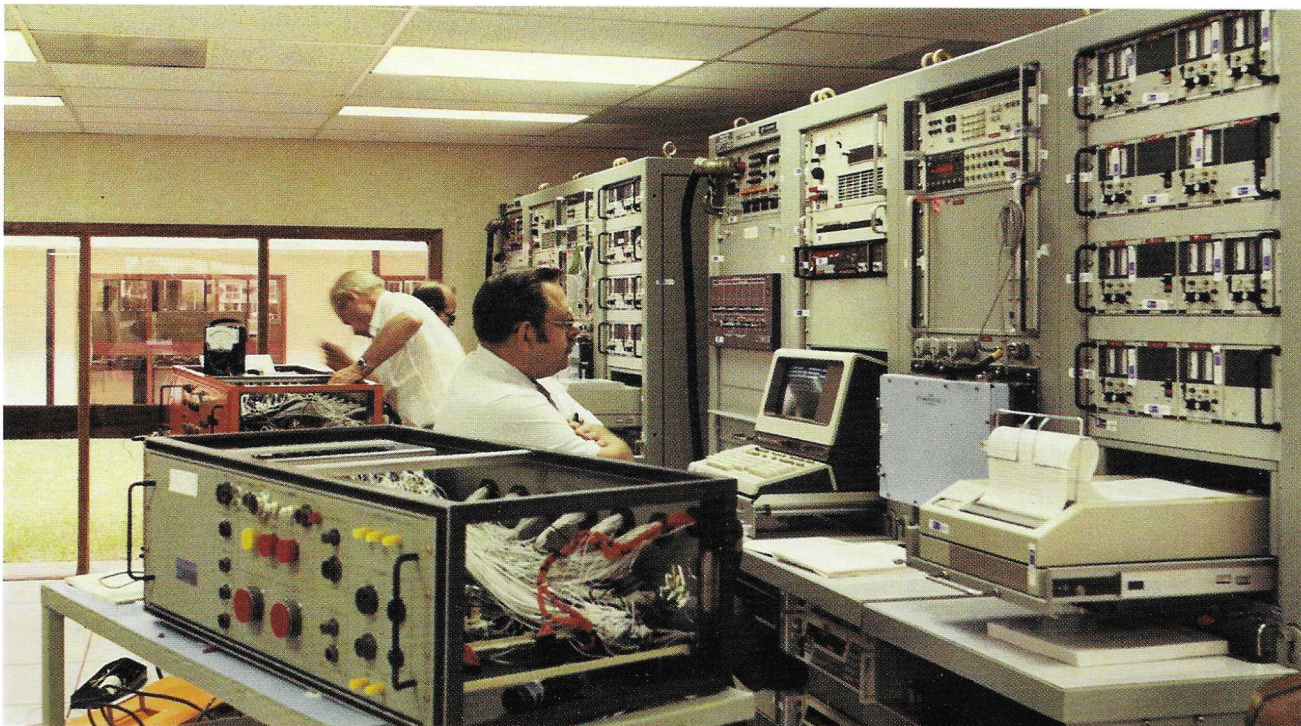
Growth within this division has necessitated the establishment of a separate operation in Orlando to concentrate on the development of application software for all automatic test systems. Test program sets developed at this operation are already in use on Harris-developed automatic test equipment as well as those systems developed by other manufacturers.

Because maintaining a firm stance in the industry means meeting tomorrow's needs as well as today's, our Support Systems Division has expanded its charter to encompass such additional technology areas as maintenance and training simulation and knowledge-based maintenance systems. Additional new facilities are helping the division comply with the latest military design and development specifications.

As military operators come to rely more frequently on simulation systems to improve operation performance, the division's Orlando Operation will be developing simulation systems for DOD training applications. The technology involved is a natural extension of the division's capabilities; Harris' automatic test systems already use simulation techniques when checking out electronic systems.

One particular need of military operators is for "suitcase" testers. These operational level test systems use advances in circuit technology to reduce their sizes—an important asset when storage space is limited. Installed in transportable units, these systems can be carried on-site for system checkout. Another important defense

Application software for automatic test systems is a specialty of Harris Government Support Systems Division's Orlando Operation. Here, specialists integrate a test program set for the Hybrid Test System.





The Harris VAST system, one of the industry's first automatic test systems, has enjoyed an outstanding track record during nearly 4 million hours of operation.

need is for test equipment that provides faster, more accurate fault isolation with less specialized operator training. Harris believes that both these needs can be met through the use of a knowledge-based Integrated Diagnostic Support System (IDSS).

Last year, Harris Government Support Systems Division designed and demonstrated the feasibility of an IDSS that incorporates methods of collecting knowledge about a weapon system, then processes that knowledge in a way that resembles human reasoning. Once the IDSS knowledge base is established, it is used to detect and diagnose weapon system failures.

With new emphasis on reducing costs, Government users are now turning toward standardization as a way to improve the life-cycle costs of their automatic test equipment. An example is the U.S. Air Force's Modular Automatic Test Equipment (MATE) concept. Understanding the Air Force's particular needs, Harris Government Support Systems Division funded a special research and development effort to establish a facility dedicated to meeting MATE specifications.

"At Harris, we're very customer-oriented," Dick Hartig said. "We started building a MATE facility about a year ago so we could design and manufacture equipment exactly to Air Force standards—proving capability, so to speak. Now we have a prototype MATE system up and running. The Air Force has cooperated with us on this project in every way, but we've incurred all the costs. Our next step is to win a MATE program."

Going hand in hand with the trend toward standardization is the DOD's encouragement of increased competition between contractors. The ultimate objective is to ensure high-quality, lower cost production of electronic equipment.

Harris Government Support Systems Division is facing the competition by developing a "factory of the future"—a facility with extensive automation equipment to handle the medium-scale production needs for Harris automatic test systems. Under its factory modernization plan, the division is centralizing its manufacturing operations, adding microprocessor-controlled automation systems, and developing an integrated information network to link engineering design, assembly, and test activities.

In today's battlefield scenario, military forces are likely to have only a few minutes warning of an impending attack. Downtime for defense system maintenance can be fatal. Harris support systems technology is helping keep our defense forces fit and ready to fight on land, in the air, and at sea.

Phil Farmer, division vice president-general manager, visits manufacturing operations at New York facilities.





QRA on the Move!

For the military's ground mobile forces, tactical superiority is the key to success. Rapidly changing battlefield tactics demand swift, dependable communications. Satellite communications deliver fast, accurate, secure data to commanders in the field where critical decisions are made.

The military's modernization program includes better support of field troops through improved communications. So when the United States Army Satellite Communications Agency determined a need for a tactically superior satellite communications antenna, it selected an established leader in the field—Harris Corporation.

In September 1983, Harris Government Satellite Communications Division began design, development, and testing of the Quick Reaction Antenna (QRA). The QRA's tactical versatility provides high-gain transmission and reception of satellite communications through intense environments (-25 °F to +125 °F, in humid or

salty air, and in 70-mile-per-hour winds). Transportability includes towing by M720 or M832 mobilizers; in the bed of an M35 truck; by helicopter lift; or in C-130, C-141, and C-5 aircraft.

Assembly is designed to minimize time and motion. The QRA can be deployed by a four-member crew in 1 hour. In addition, the 12 removable panels in this 20-foot, 16-panel reflector are completely interchangeable, and alignment between the feed and reflector is factory-set so that no field adjustments are required.

Lightweight components facilitate deployment. The 12 removable panels weigh 25 pounds each. The feed, which weighs 90 pounds, can be lifted and rotated into place easily by two people. The detachable subreflector weighs 12 pounds, and its high-efficiency illumination optimizes phase distribution across the reflector.

The QRA, which supports the Defense Satellite Communications System (DSCS), can interface with eight DSCS and TACSAT (tactical satellite) terminals: AN/GSC-49, AN/TSC-85A, AN/TSC-86, AN/TSC-93A, AN/TSC-94A, AN/TSC-100, AN/TSC-100A, and AN/MSQ-114.

Four first-article QRA s are currently undergoing qualification tests. Environmental testing was conducted at Eglin Air Force Base in Florida. Mobile and transportability tests are currently in process at Aberdeen Proving Grounds in Maryland; helicopter transport and aircraft fit check tests with C-130 aircraft will also be conducted. Performance tests are completed at the specially designed multimillion-dollar Harris Malabar testing facility.

When the qualification phase is completed, production will begin at a minimum rate of four antennas per month. Under the current \$26 million contract, production of 149 QRA s will continue through December 1987 and will include 136 single-carrier versions and 13 intermodulation-free, multicarrier versions. Through the use of production tooling and a much simplified design concept, the QRA can meet its production requirements while achieving maximum cost-effectiveness.

The Quick Reaction Antenna achieves high-quality performance under rugged conditions with no field alignment operations required.



Harris Develops Software for the Air Force

Harris Corporation Government Systems Sector has been awarded a \$12.5 million contract by the U.S. Air Force Rome Air Development Center, New York, to develop the Tester Independent Support Software System (TISSS). Harris is scheduled to complete development within 28 months.

The sector's Very High Speed Integrated Circuits (VHSIC) Operation will perform the program and system management. The software will be developed by Harris Government Information Systems Division's Software Operation.

Frank J. Lewis, senior vice president and sector executive, noted that this program demands a wide range of skills and experience. These include the production, qualification, and test of military specification integrated circuits, as well as design and fabrication capability at VHSIC levels of complexity; development and integration of large software systems; and development of automatic test equipment for the military. "Harris has demonstrated its ability to integrate all these aspects into a successful program," he stated.

The primary mission of the TISSS is the automated generation and maintenance of test programs for VHSIC and other very large

scale integrated (VLSI) circuits. The system will allow the U.S. Government to develop, maintain, and distribute high-reliability specifications in a standardized format that is easily transportable and can be accessed by computer.

The ability of the TISSS to automate the development of test specifications is essential to the use of new VHSIC-level circuits which have been qualified by the Government. These new circuits are so complex that specifications on paper alone cannot adequately represent their behavior in any given system. Another critical problem to be solved by TISSS is the automated generation of the thousands of test patterns required to verify that a VHSIC-level chip meets its specification before it is installed in a system.

TISSS will store chip design and test data in a standardized VHSIC hardware description language. The system incorporates a family of simulators, test pattern generators, and support tools needed to generate specifications and tests in machine-readable form.

TISSS specification and test program data will be expressed in computer language that is independent of specific design and test systems. Harris will demonstrate that this "Tester-Independent Data Base" can be used to generate chip tests that will run on a specific microcircuit tester.

BM/C³ Win

Harris Government Special Programs Operation has been awarded a Battle Management/Command, Control, and Communications (BM/C³) Architecture Development Study contract by the U.S. Air Force Electronic Systems Division at Hanscom Air Force Base. The contract, awarded in July, is valued at \$668,000.

According to A. J. Scott, vice president of the Harris operation, the study is critical to President Reagan's Strategic Defense Initiative (SDI) program. Harris will define architecture alternatives for a BM/C³ system required for the

boost and midcourse phases. The company will also provide functional descriptions and comparisons of the architectures, evaluate the architectures against specific Government criteria, and provide top level system modeling.

"The system we're helping develop will coordinate, manage, and control the entire first two phases of the SDI network," Scott said. "It will also provide the information that will be handed over to the BM/C³ system used during the SDI program's terminal phase."

General Research Corporation is teamed with Harris on the program and will provide technical support in several key technological areas.

A/J Systems Production Starts

Harris Government Satellite Communications Division has received a major contract award to produce antijam communications systems for the Army, Air Force, and Marine Corps. The contract, with an initial value of \$94,114,387, was awarded in late August by the U.S. Army Communications Electronics Command at Fort Monmouth, New Jersey.

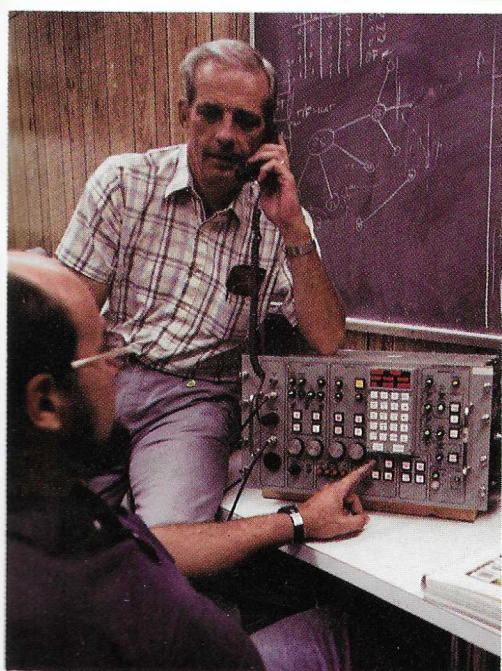
According to Richard M. Farotto, vice president-general manager of the Harris division, the AJ Control Modem is the first system to provide protection against enemy jamming for tactical satellite communications terminals and, as such, is a major step in providing survivable communications for the U.S. Armed Forces. Farotto said that the system provides multiple channels of communications to its users even in the presence of severe jamming. In addition

Integration of the AJ Control Modem into tactical satellite communications terminals is a major step in providing survivable communications for the U.S. Armed Forces. The modem is the first system to provide multiple channels of communications even in the presence of severe jamming.

to providing antijam communications, the system also provides a robust control capability that permits uninterrupted management and network reconfiguration during hostile actions.

The AJ Control Modem will be integrated into the Ground Mobile Forces Tactical Satellite Communications Program, which was developed by the U.S. Army Satellite Communications Agency to provide critical long-haul communications for the Armed Forces. Harris is a major supplier of satellite terminals for this program. The modem will be manufactured at the Harris Government Systems Sector's Malabar production facility under a 32-month basic contract with an option for an additional 12-month production phase.

Harris Government Satellite Communications Division business areas include all aspects of ground-based satellite communications networks, satellite communications control, and advanced technology related to these systems. The technologies range from real-time software for control of microprocessors to state of the art mechanical structures and all the disciplines that support the development of satellite communications terminals.





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HARRIS CORPORATION
GOVERNMENT SYSTEMS SECTOR
P.O. BOX 37, MELBOURNE, FL 32902

